ATTENUATION OF RFI BY INTERFEROMETRIC IMAGING ARRAYS

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ABSTRACT

Attenuation and/or removal of extraneous signals is critical in radio astronomy, where the spectral ¤ux density of extraterrestrial radiation is many orders of magnitude less than that of nearby, man-made emissions. With the increased demand for wide bandwidths – in part due to tuning requirements, and in part due to the need for increased sensitivity – and at the same time with the increased commercial use of radio frequencies, current and future radio astronomical telescopes must pay special attention to mitigation of unwanted emissions.

It has long been known that imaging interferometers have an advantage over total-power (‘single-dish’) telescopes, due to their use of the phase of the correlated signals. As the interfering signal originates from a different location than the desired signal, the phase properties of the correlated signal are distinctively different than that of the desired astronomical signal. Averaged over time, a signi£cant attenuation of the unwanted signals will occur, relative to desired signals.

The amount of attenuation is a complicated function of many variables – frequency, baseline length, sky location, and the durations of the interference and/or observation. Past work on the response of an interferometer to RFI have given functional forms permitting calculation of the expected attenuation, these are not explicitly cast in a useful form allowing easy estimation of the attenuation.

The current work derives the attenuation of unwanted signals by a phase-tracking imaging interferometer from the point of view of astronomical imaging. So far as the correlator and imaging processes are concerned, a local source of unwanted emission is no different from the emission from a strong astronomical source located in a far sidelobe. A practical expression allowing calculation of interferometric attenuation as a function of source location, baseline length, frequency, and duration is derived, and its predictions compared to detailed simulations.

Ongoing work on the practicality of accurate interfering signal subtraction from post-correlation data, using methods well known to radio astronomers who remove interfering background sources, will also be described.